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B7A AAHB

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JP 2001091194 A
US 4961393 A
US 4625668 A
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(54) Abstract Title
Defensive net for protecting ships or harbours from attack

(57) Apparatus for protecting ships or harbours from attack by vessels comprises a capture device formed by a net 100 supported above the water's surface by masts attached to the net, which maintain the net in an upright orientation. The masts are supported by a plurality of buoys 200 which float on the water's surface while ballast weights are secured to the lower ends of the respective masts. Anchors 300 are connected to sections of the net for providing a restraining force on the net against predetermined movement of the net. The anchors may impart a downward and/or lateral force to the bow of an attacking vessel when it strikes the net. The application also discloses apparatus for protecting ships and harbours from attack by vessels which comprises a barrier formed by a resilient water-filled 'wall' structure Fig 7.

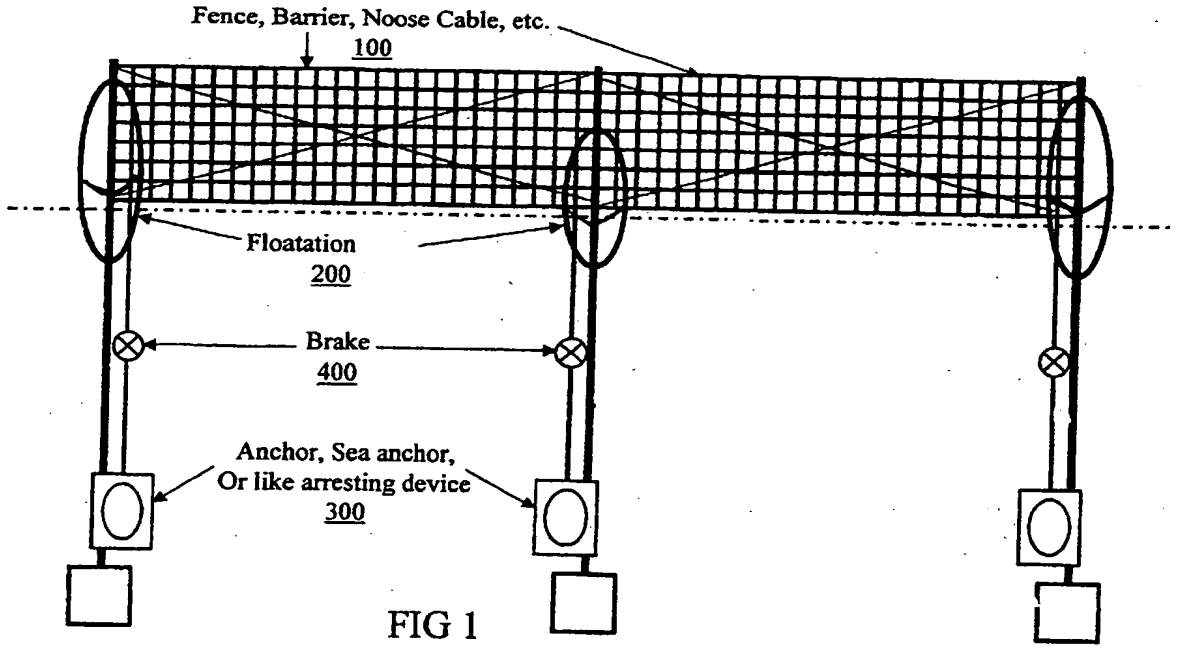


FIG 1

GB 2 375 739 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

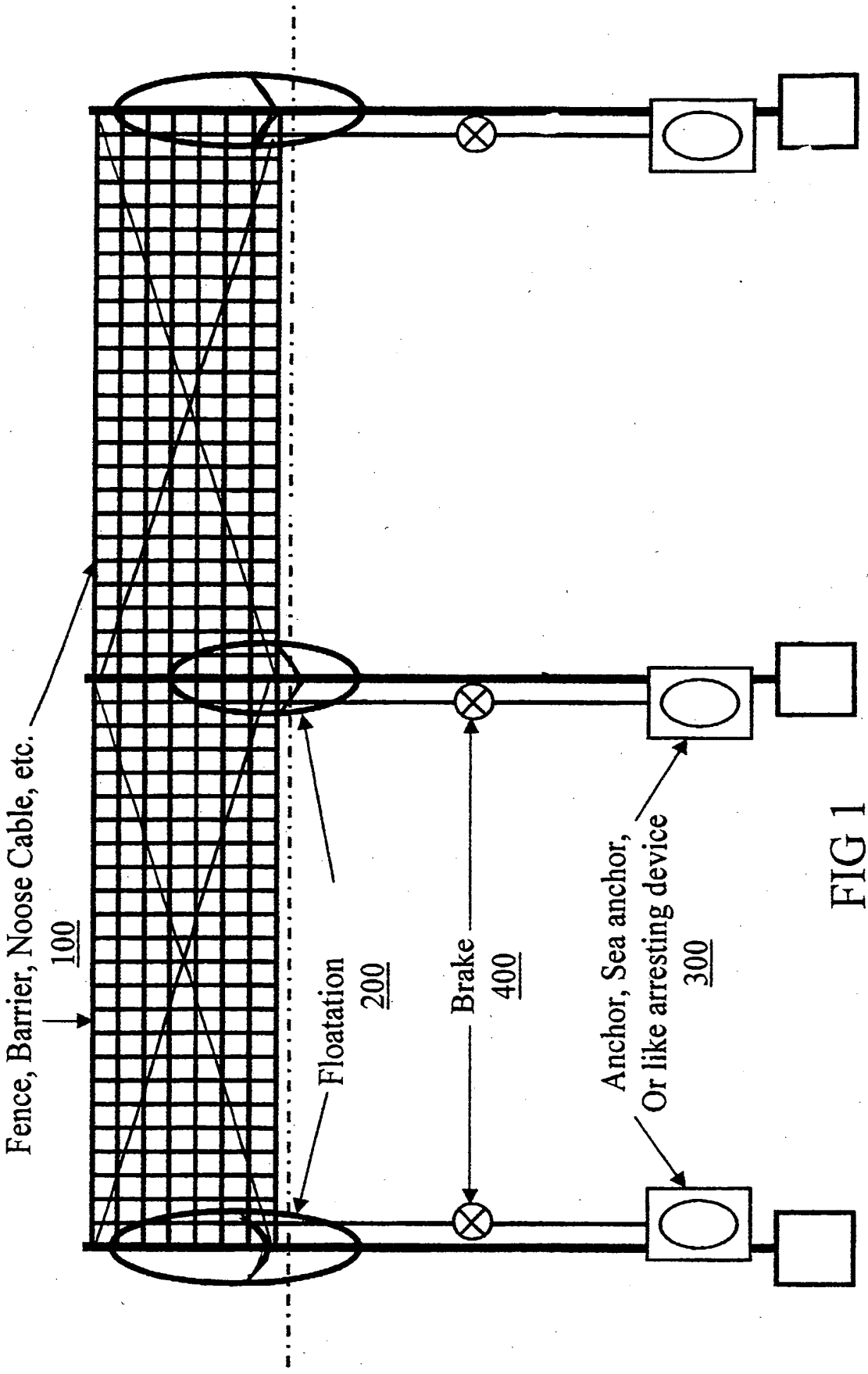


FIG 1

FIG 2

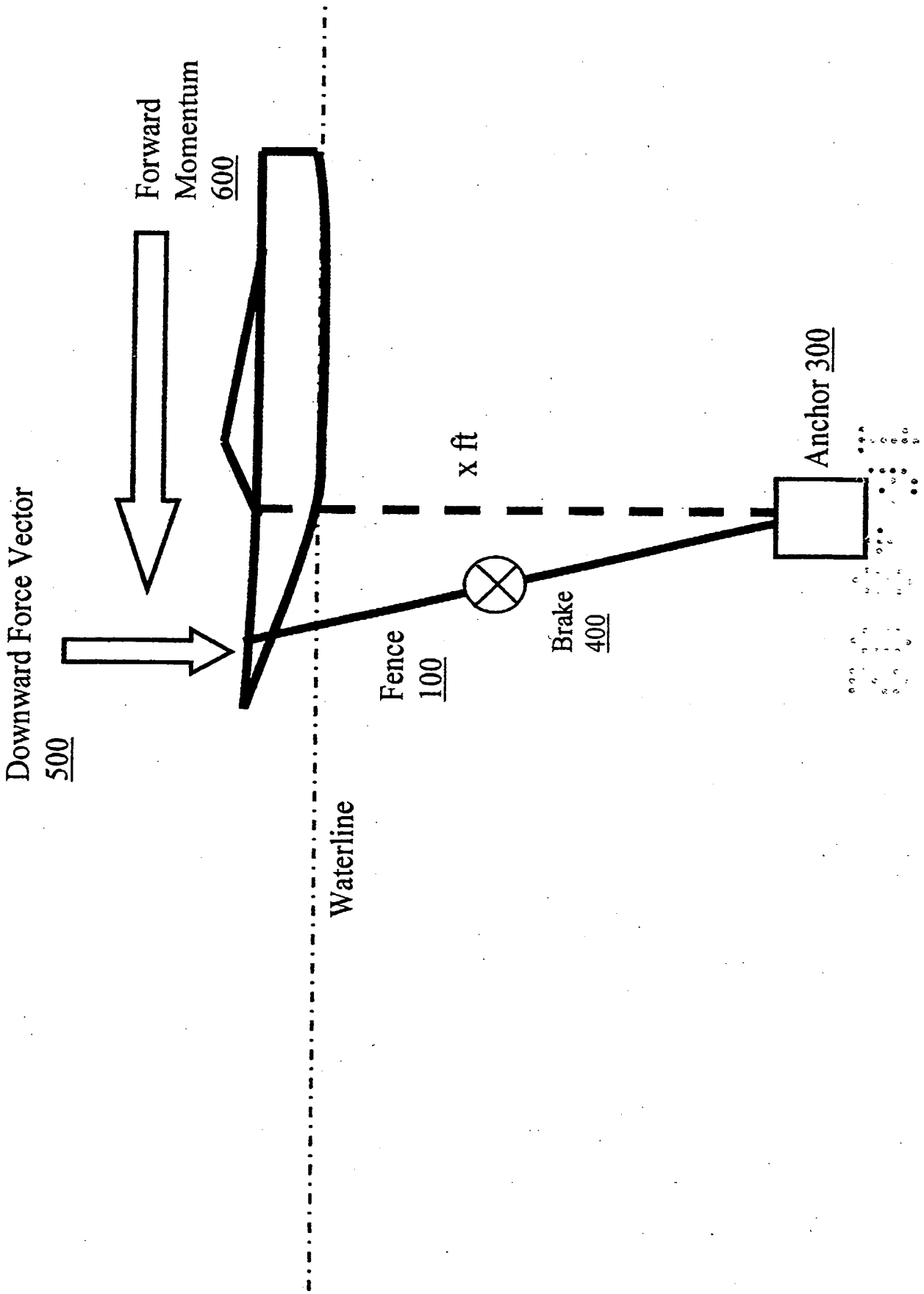


FIG 3

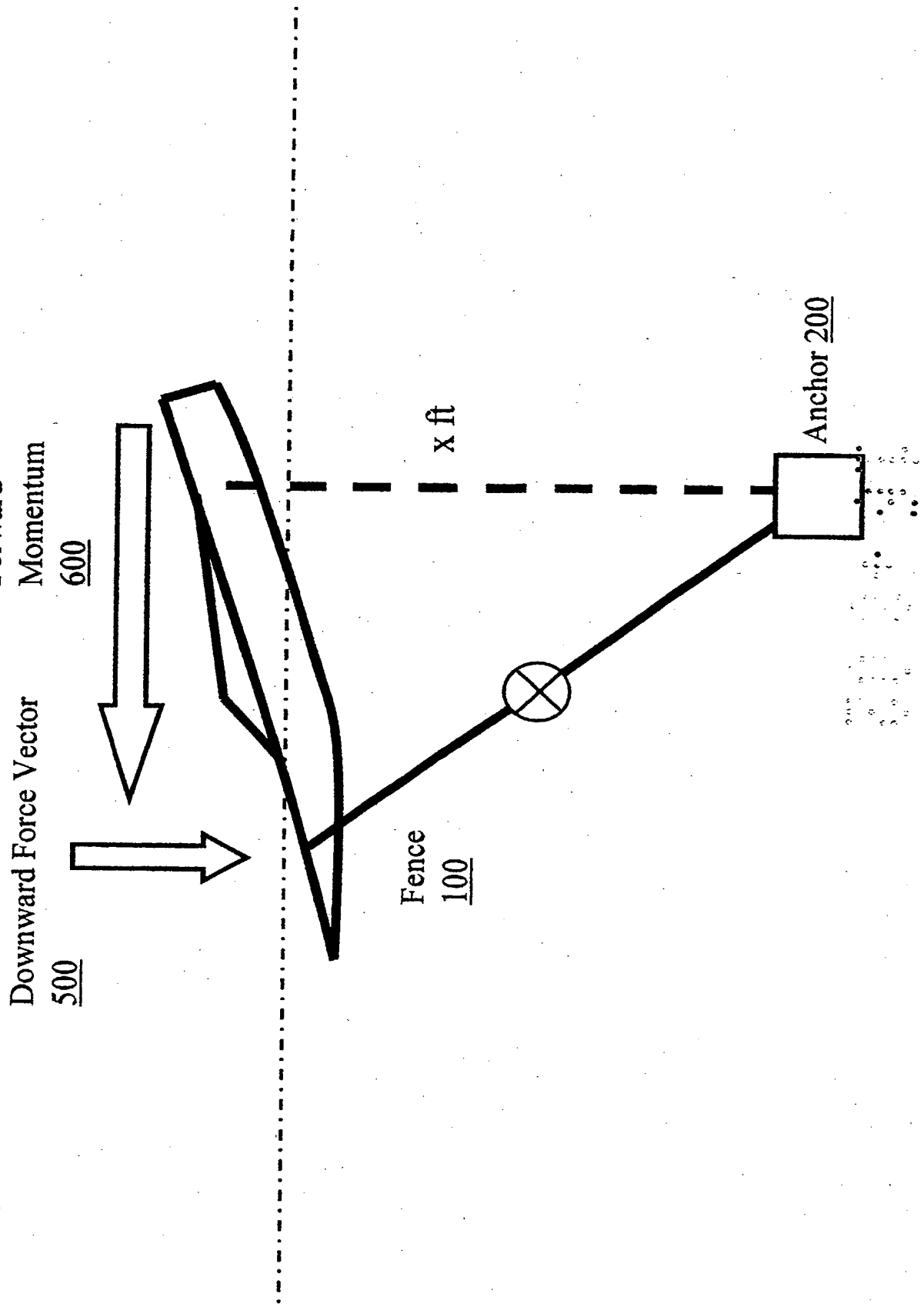
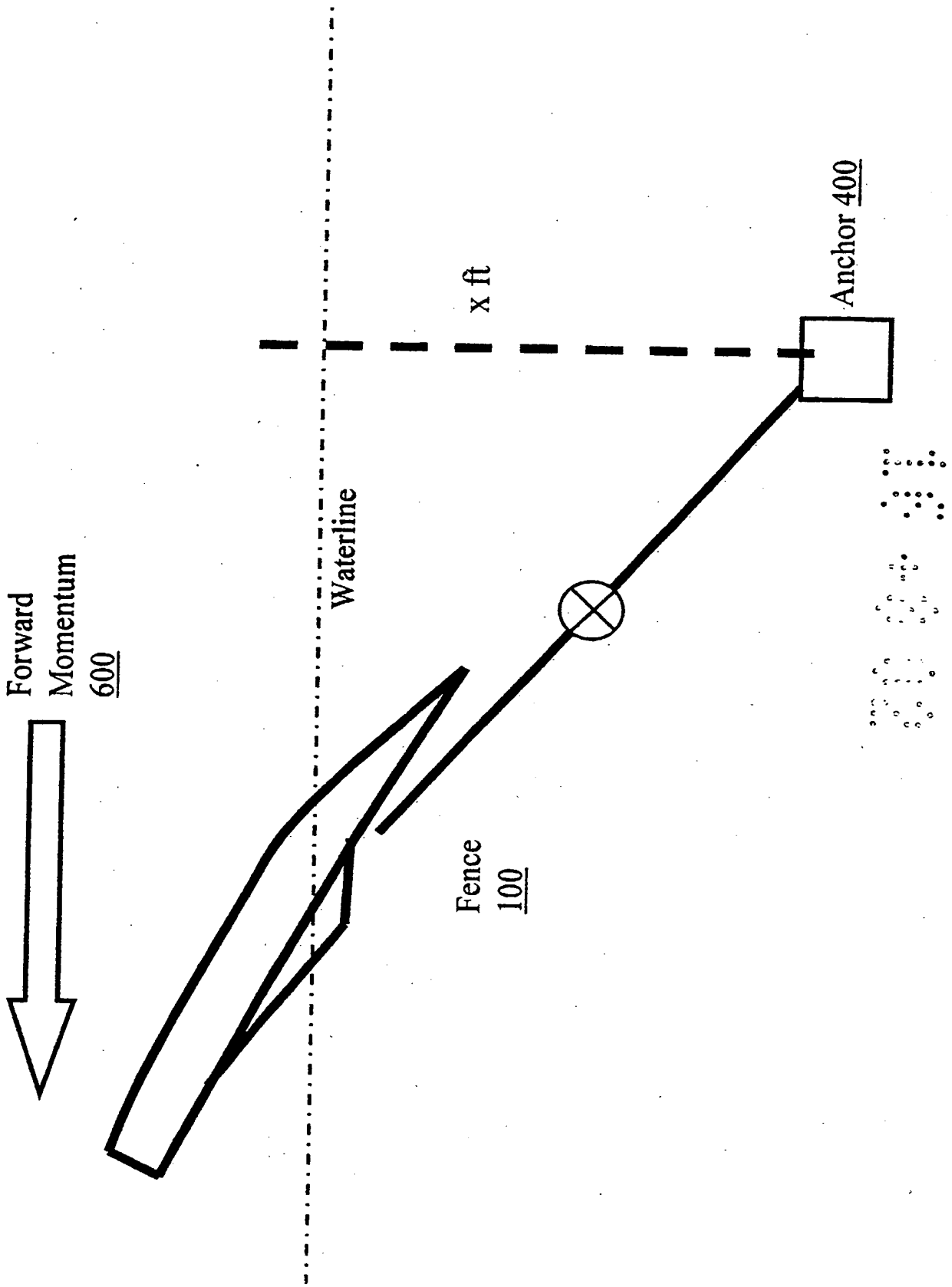


FIG 4



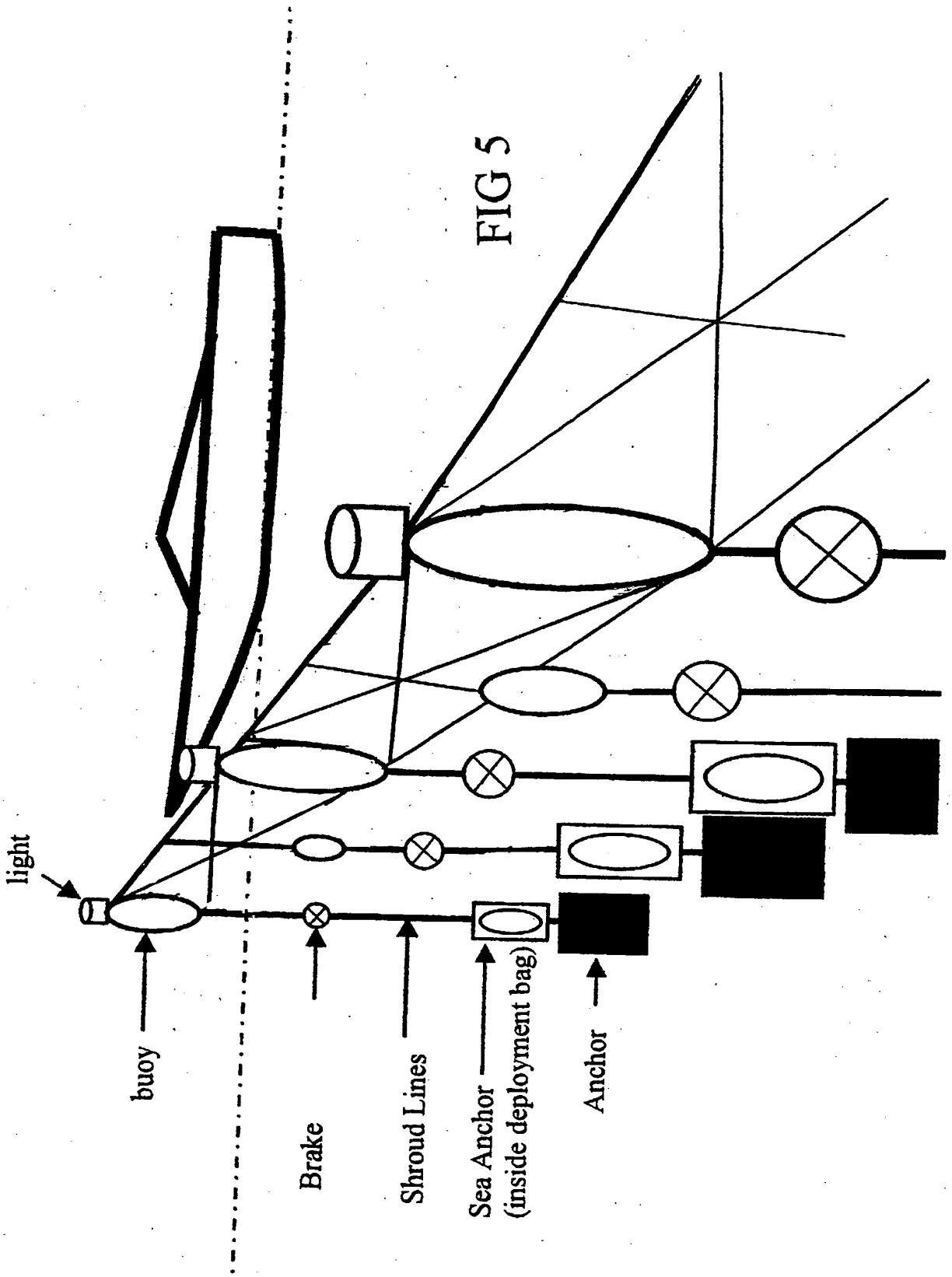
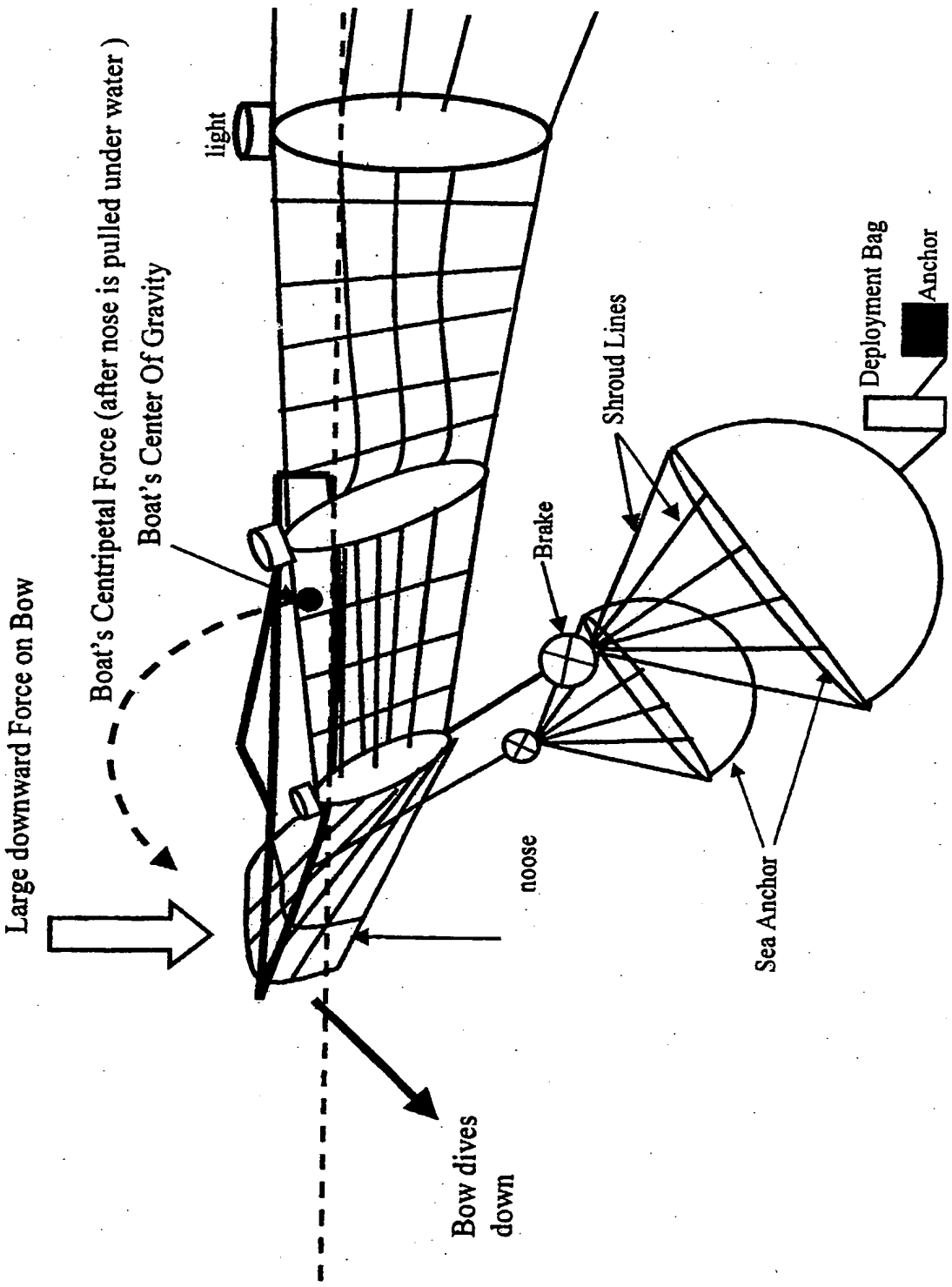


FIG 5

FIG 6



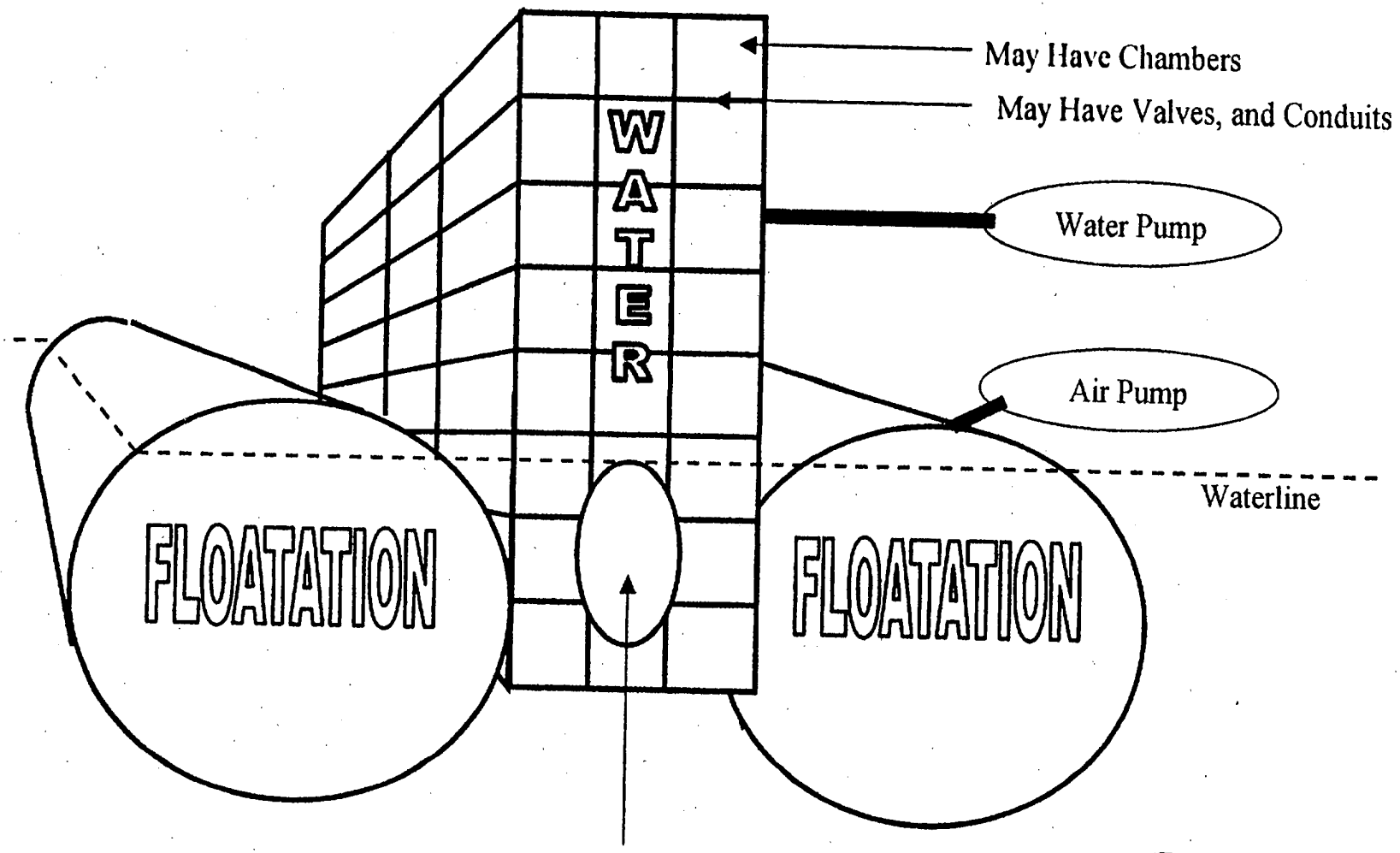


FIG 7

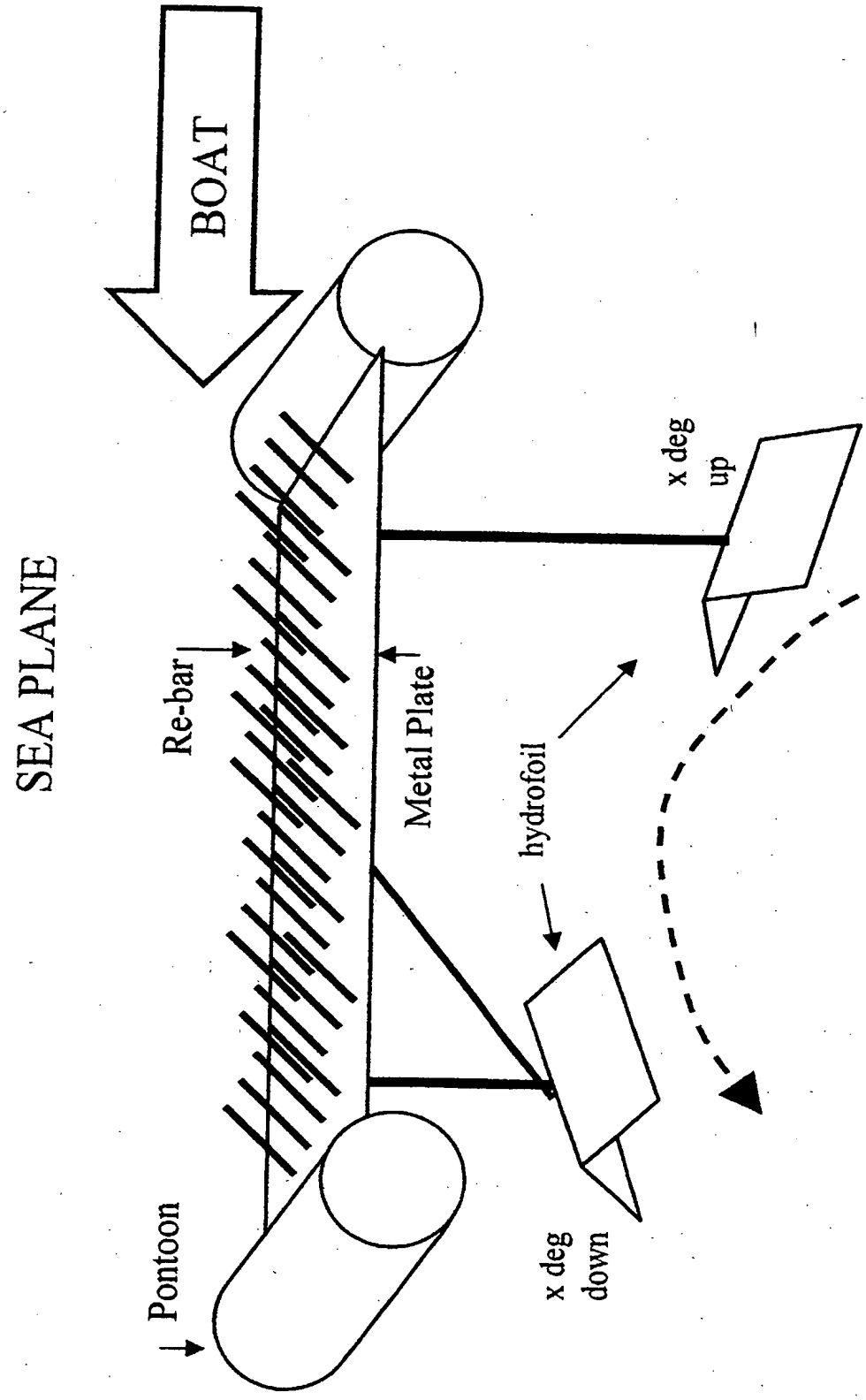


FIG 8

FIG 9

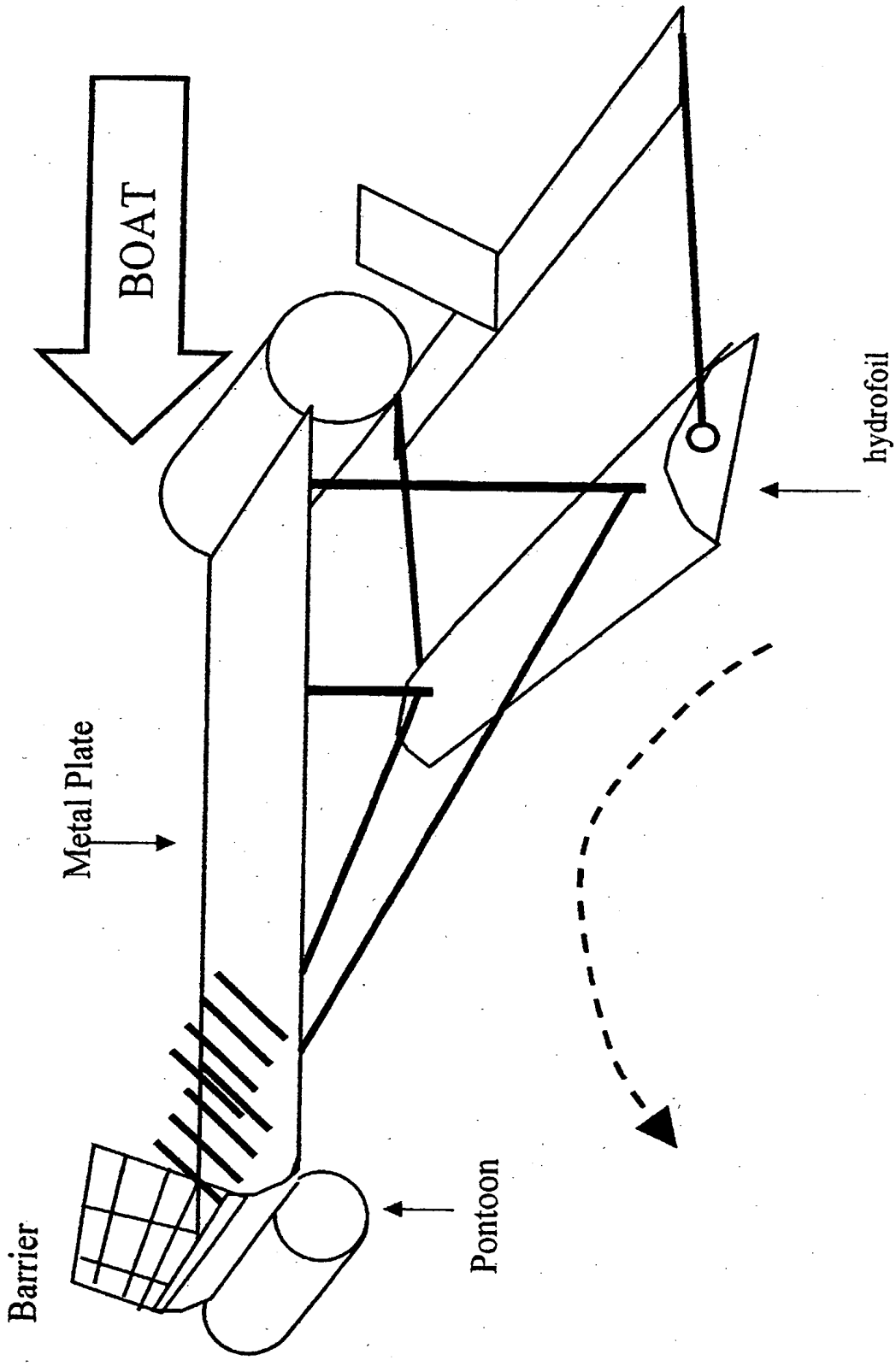
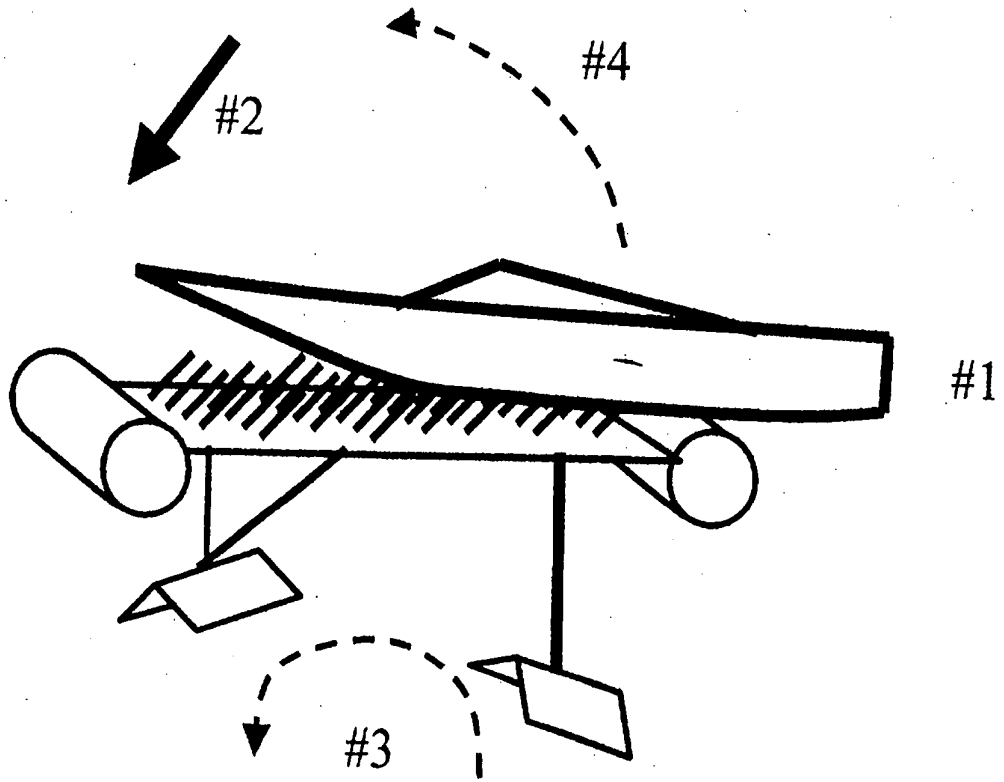


FIG 10



#1Boat caught on re-bar
#2 Bow forced down as …
#3 hydrofoils pull bow down and flip stern up
#4 flips boat over

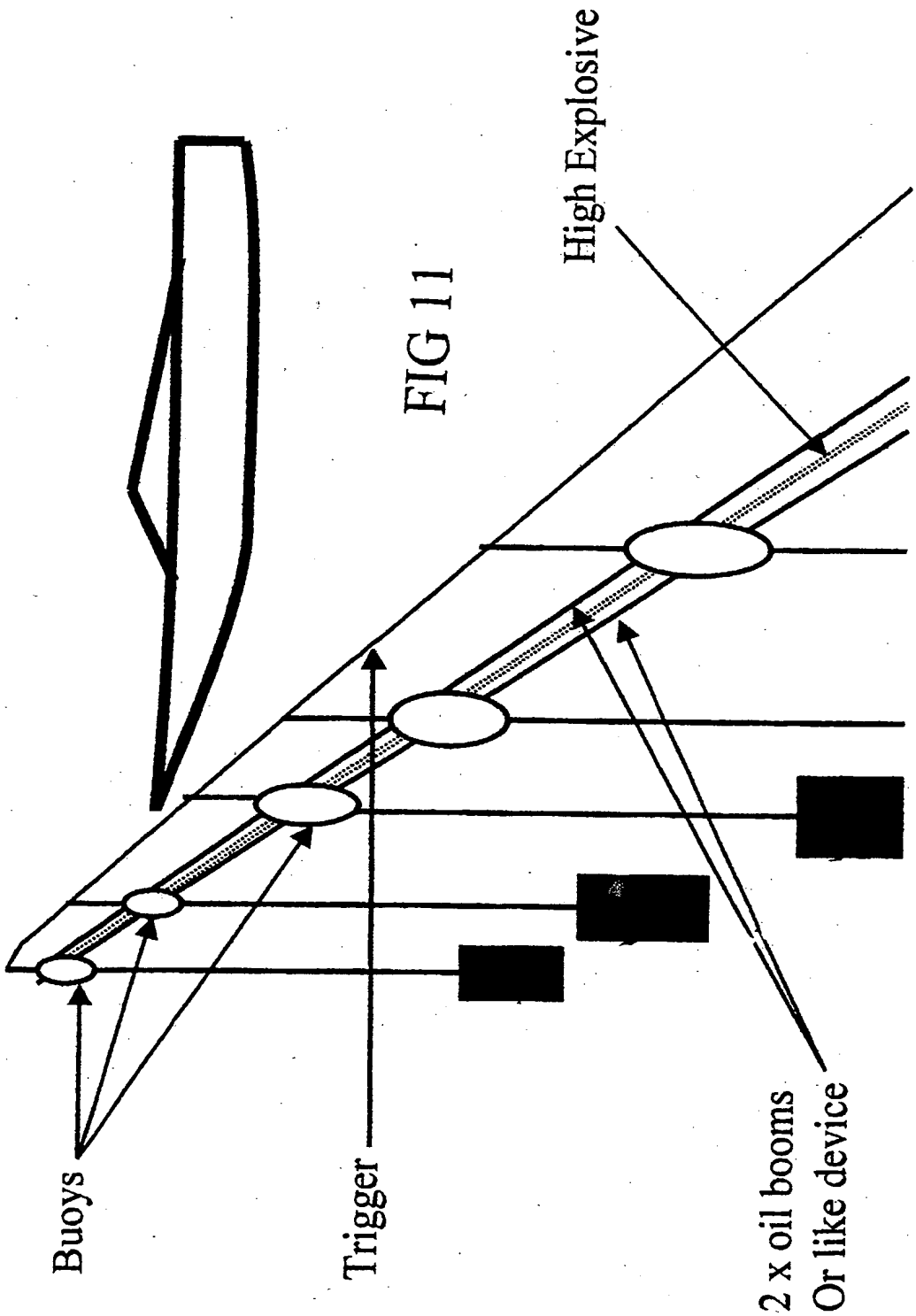
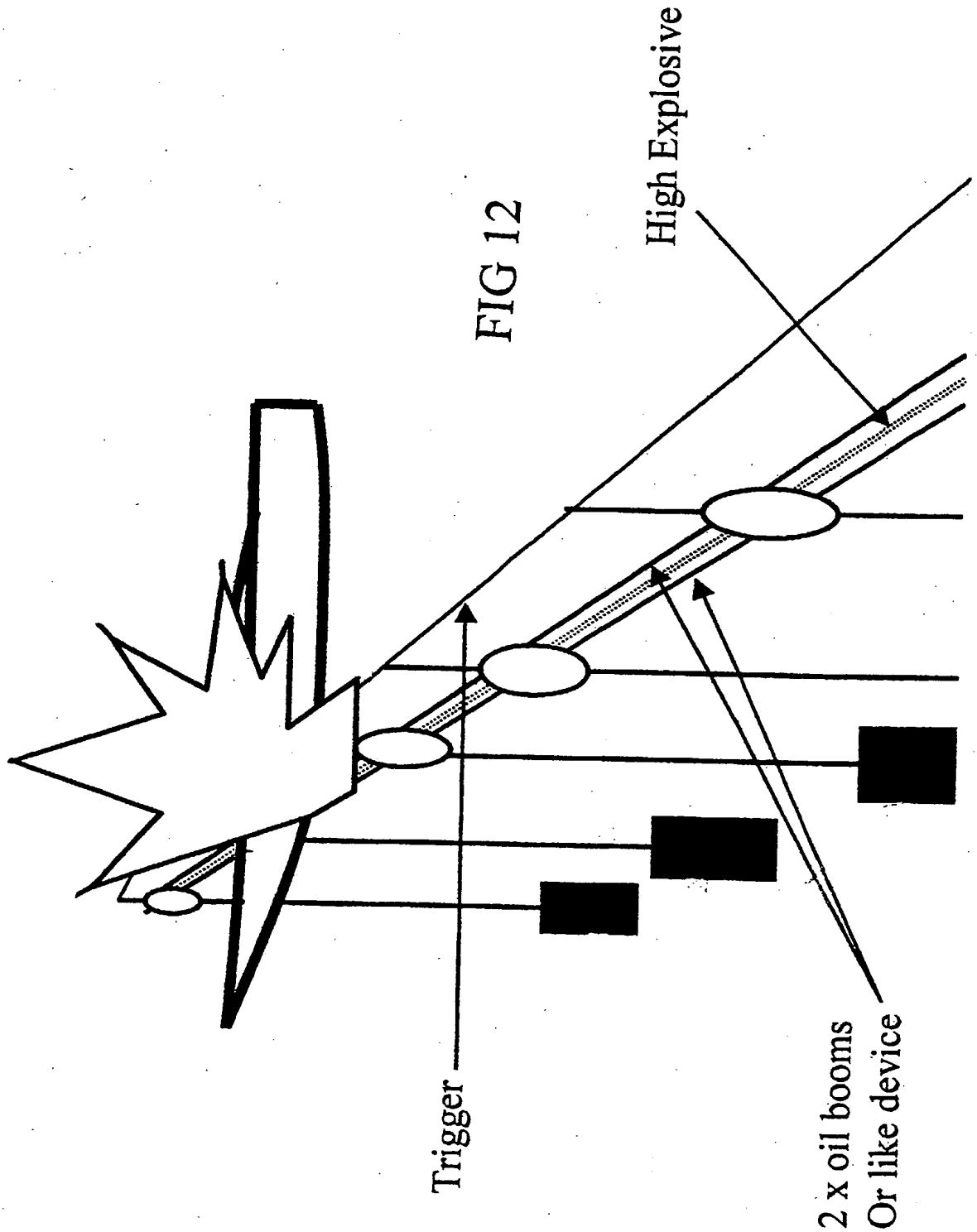


FIG 11

FIG 12



APPARATUS AND METHOD FOR PROTECTING SHIPS AND HARBORS FROM ATTACK BY VESSELS

The present invention relates to military systems and, in particular, Force Protection of Naval assets.

During peacetime, Naval assets have been vulnerable to attack from small, fast vessels when they are in port. The USS Cole was vulnerable because the ship's captain could not differentiate between boats that were authorized to come along side and the terrorist vessel that exploded beside it.

Because of the USS Cole incident in Yemen and the threat of terrorism against naval assets, the Navy is searching for a viable solution to its problem. . In the past, the Navy has tried to protect its assets by putting out buoys, logs, fenders or oil booms in the hopes of stopping these craft by creating a wall that would stop penetration into restricted areas. They have placed guard boats in the water to intercept approaching craft. In wartime they have mined harbors in order to secure their vessels, but there is no system designed specifically to stop small boats from entering restricted areas.

There are several difficulties to overcome when designing such a barrier. The barrier itself must be portable so that it can be deployed from a ship when it is needed. It must be able to stop a vessel weighing 20,000 lbs moving at 80 ft/sec. It must also be able to withstand the rigors of an ocean environment, such as strong tidal currents and swells.

The present invention overcomes the difficulties discussed by using the ocean and the force of the vessel itself to stop, destroy or inhibit the forward movement of the craft. The present invention may use the force of the attacking vessel and the ocean itself in a variety of different ways.

The barrier may capture the bow of the vessel as it comes in contact with the barrier using a fence, net, cable or other device that is itself attached beneath the surface to an anchor, auger, sea anchor or like device. As the vessel continues forward, the fence, net or cable is pulled taught and the forward momentum of the vessel is translated down onto the bow. Once the bow is underwater the center of gravity of the vessel will be higher than the bow, causing severe drag on the bow, plunging the bow deeper below the surface. If the vessel has enough velocity, the stern of the vessel will rotate around the submerged bow, then the stern will flip over the bow, capsizing and destroying the vessel. If the vessel does not have enough velocity to capsize, the majority of its force will be spent on the ocean as the bow drives in, stopping it.

It may, in a sense, use the ocean itself as a barrier by bringing the ocean up into a wall that would stop destroy or otherwise arrest the attacking vessel. A container, either flexible or inflexible in nature would be filled with seawater and supported above the surface by containers filled with air or other floatation type material below the surface that would more than equal the volume of water above the surface. This would not only serve as a barrier but would also serve as blast protection, to mitigate the effects of an explosive device.

Another way to redirect the force of the attacking vessel is to harness its inertial energy and force it to capsize. The barrier may consist of a platform on or just below the surface with an arresting device and a hydrofoil underneath which would, when the vessel rode onto the platform, take the energy imparted to the platform and push the hydrofoil through the water, pushing the rear of the platform up and over, capsizing the vessel.

The barrier could simply consist of sharp objects that would rip into the hull of vessel when it hit the barrier at high speed. This could be combined with explosives that would damage the hull of the vessel in such a way as to stop the vessels forward movement.

The present invention could include a device that would wrap around the propeller,

snagging the vessel.

In accordance with the preferred embodiment, the method and system of the present invention that will now be discussed are varied in their approaches to achieve the desired result of destroying, disabling, arresting or otherwise stopping a vessel from passing through a barrier.

Protection apparatus and methods of providing protection against attacking vessels, will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a front elevation of a first embodiment of the protection apparatus;

Figure 2 is a side elevation of a vessel engaging the apparatus of Figure 1;

Figures 3 and 4 are side elevations corresponding to Figure 2 showing the vessel in different positions of engagement;

Figure 5 is a perspective view of a second embodiment of the protection apparatus employing a sea anchor;

Figure 6 is a perspective view of the protection apparatus of Figure 5 when engaged by a vessel;

Figure 7 is a perspective view of a third embodiment of the protection apparatus;

Figures 8 and 9 are perspective views of fourth and fifth embodiments of the protection apparatus;

Figure 10 is a perspective view of a vessel engaging the apparatus of Figure 9;

Figure 11 is a perspective view of a sixth embodiment of the protection apparatus; and

Figure 12 is a perspective view of a vessel engaging the apparatus of Figure 11.

In one embodiment, the present invention is a fence or other barrier above the surface that is attached by a cable, rope or chain to a sea anchor, ship's anchor or immovable or heavy object below the fence.

The method of the present invention will now be discussed with reference to Figures 1 to 4. In the preferred embodiment, the present invention includes (in Figure 1) a fence, barrier, cable, noose or the like 100 held above the water by a floatation mechanism 200. The fence itself can be made of nylon or polymer rope, steel cable, or a sheet of strong material such as nylon, Mylar, canvas, Kevlar or the like. The noose and cable that is attached to the anchor may be made of nylon or polymer rope, steel cable, nylon straps or the like. The fence etc. 100 is attached to an anchor, sea anchor or the like some distance underwater 300. The anchor can be a sea anchor, a parachute, a sea-drogue, made of high strength nylon etc. or a fixed anchor, auger, or heavy weight.

When the vessel attempts to break through the fence, barrier, cable, noose or the like 100, it envelops the bow of the vessel Figure 2. The vessel continues through the barrier until the line is taut, at which point a downward force vector 500 will be applied to the bow of the vessel as illustrated in Figure 2. The bow will be pulled underwater and under the center of gravity of the vessel Figure 3, and if the forward momentum of the vessel 600 is great enough, then the vessel will capsize Figure 4. If the momentum is small then the bow will go down and the vessel will be arrested against the barrier 100.

If the cable to the anchor is not vertically positioned, but instead is positioned at an angle in the plane of the fence, then the downward force vector applied to the bow of the vessel will be downward and to the side. This will cause the bow to both plunge downward and sideways causing the vessel to suddenly turn sideways while plunging which will cause the vessel to roll over violently rather than pitch the stem over the bow (pitch poling or pearling). In either event the vessel will suffer severe damage and will be rendered useless.

The present invention may contain a sea anchor, drogue or the like which would cut down on the weight of the barrier Figure 5. The sea anchor would be folded into a deployment bag with the shroud lines extending out of the bag. This would cause the sea anchor to deploy

out of the bag quickly Figure 6. The mouth of the sea anchor would have bungee cords or some elastic device attached to it so that when there is no tension on the shroud lines, the mouth would close and therefore would not be affected by the current. But when significant force is applied to the anchor by the attacking vessel snagging the fence, the mouth will open.

In a system that is used in a more permanent capacity, an anchor made of metal or other heavy strong material but shaped like a parachute, or a bell, could be used. This anchor would use not only its own weight but also the weight of the water in the concave bell in order to turn it into an incredibly heavy weight. It would be able to handle the effects of high stress loads, and long exposure to water without breaking.

To limit the load on the cable, so that the load will not exceed the breaking load of the cable, a portion of the cable may be wound onto a spool that contains a brake 400 which can be set on the cable that would apply the wanted pressure, so that the system will not break down if too much force is applied. If too much force is applied then the brake 400 will release reducing the force to a manageable level. The incorporation of this spool and brake are optional to the main operation of the system.

A cable spool apparatus containing a spring mechanism attached at some point along the cable may be needed to keep the fence straight as the tide rises and falls. The apparatus will contain a brake that will lock the cable when the cable is suddenly pulled out above a certain speed. The spooling apparatus described in the preceding two paragraphs may be incorporated in a single apparatus with one spool, or it may be incorporated in two separate spool apparatuses.

Another way to keep the anchor line at ninety degrees to the surface in the rising and falling tides is to have a winch system on the surface or underwater that pulls in or lets out cable depending on the tide. The winch could be worked manually or it could be pre-

programmed or radio controlled.

In another embodiment the present invention may consist of erecting a vertical wall of water of sufficient thickness and height above and possibly below the water surface to stop, destroy or disable a vessel attempting to go through the wall Figure 7. The wall of water above the surface will be contained in a structure resembling a water tank with one or more compartments. The walls of the water compartments may be flat or curved. The walls may be made of solid, relatively stiff material, or it may be made of flexible sheet material such as rubberized material, canvas, Mylar, Kevlar or the like.

The wall of water will be supported above the water surface by a bouncy system that will be constructed so that the wall will be stable under windy conditions or in ocean swells. In order to hold the wall in place, the wall could be either anchored to the bottom, or tied along side the ship, pier or other structure that is to be protected.

The wall of water may be chambered with a material in such a way so that if the wall is penetrated at a point the water inside the wall will not totally drain out. The chambers may be flexible so that the other chambers in the wall will bulge and fill the gap left by the empty chamber. The chambers may be of any configuration, either longitudinally, laterally, honey-combed or the like. The chambers may be connected to one another. The material may be made of rubber, nylon, plastic etc. A water pump will be used to fill the chambers with sea water.

The individual chambers may have valves in them that allow water to escape when the pressure of the water at the time of impact threatens to rupture the chambers. Before the pressure threatens to rupture the chambers, the valves will allow the water to escape, thus lowering the pressure. The valves may be of any construction and may be placed on top or to the sides of the chambers. The chambers could also be open to the air.

Not all the chambers need to be filled with water and could be filled with air in order to lighten the wall. Flexible air chambers in the wall itself may be filled first and then the wall would be filled with water. The hydrostatic pressure would squeeze the air chambers at the bottom, allowing the volume of water to be greater at the bottom then at the top. This would give the wall more structural stability and would make the wall lighter, while keeping most of the water at the bottom to insulate the ship against attack by explosives or small boats.

The face of the wall that will resist the attacking vessel may have a sheet or sheets of rigid material such as tough plastic, Kevlar or metal that will allow the energy to dissipate over a larger area.

In order to support the wall, floatation devices filled with air, Styrofoam etc, are placed and secured under and around the wall with a total displacement greater than the volume of the water in the wall above the surface.

The wall could be placed at any distance from the ship that is being protected. If the apparatus is placed in direct contact with the hull, it will act as a blast protector that will mitigate the explosive effect of any device, including improvised explosives, missiles, torpedoes etc. that are employed to destroy the ship.

In this application the present invention could extend below the water line, covering the ship's hull in order to protect the ship not only from surface craft but also from sub-surface attack. Underwater, the ship would have a water filled bladder sandwiched with air bladders. This would reduce the effect of an explosion below the water line. This would extend from below the waterline to as high above the water line as deemed necessary to protect the ship. This would then present an air-water-air barrier "cocoon" that envelops the hull of the protected ship above and below the water line.

By making this wall out of a thin, flexible material that can be inflated with air and filled with water, the system can be folded up so that it can be carried on the deck or attached to the railing of the ship when the ship is underway. It can be rolled up and stored in a tubular container to protect it while the ship is underway. When the ship is pier-side it can be inflated and deployed in order to protect itself from attack.

When the system is deployed along the side of the ship, gangways could be deployed over the barrier and down to the water so that a tender vessel can be loaded and unloaded, all the while protecting the ship against attack.

In another embodiment, a less conspicuous system may be used that relies on a hydrofoil apparatus attached to the aft position of a flat plate, floating at or close to the surface Figures 8 to 9. The flat plate has a "capture device", such as a fence, spikes or other device that will catch the attacking vessel as it attempts to cross over the fence barrier. The entire plate/hydrofoil apparatus will then move forward carried along by the forward momentum of the vessel.

The forward edge of the plate is curved upward to an angle of about 45 or 60 degrees. The aft hydrofoil is angled upwards and is attached to the aft of the plate apparatus. The aft hydrofoil is mounted on a long arm that places it deep below the surface. When the fast moving vessel slides onto the plate and is captured with its bow near the front of the plate, the forward movement of the boat carries the plate and hydrofoil system forward, resulting in the hydrofoil lifting the aft of the plate (and vessel) high in the air Figure 10. The forward part of the plate hydroplanes along the surface on the water, and as the aft end rises up, the forward end of the plate dives under water. This suddenly stops the forward motion of the forward part of the plate, resulting in the vessel being thrown up and over its bow, capsizing, tumbling and severely damaging and destroying the vessel.

In another embodiment, a method for destroying, disabling or otherwise arresting an incoming vessel is to place a barrier below the waterline that would cause damage to the vessel's hull. The device could be made of metal or other hard substance that would be angled in such a way that when a vessel hit the barrier at high speed, the hull and props would be ripped apart, thereby impeding the forward progress of the attacking vessel. The barrier would be attached to a floatation device that would keep the barrier at or just below the surface. The floatation device could be made of air, Styrofoam or like material. The barrier would be anchored to the sea floor, in order to keep it stationary. In order to deter the attacking vessel and to keep other vessels from unsuspectingly running into the barrier, a fence would lie above the surface.

In another embodiment, the barrier itself could contain explosives that would aid in the destruction of the hull of the vessel. Any type of explosive, such as C-4, Composition B, PETN or like material would float atop the barrier so that the explosives is on the surface Figure 11. When the attacking vessel attempts to ride over the barrier, the explosive would be in intimate contact with the hull and surrounded by water. Because water is incompressible and therefore a perfect tamp, the explosive energy would be forced into the hull of the vessel almost exclusively, destroying the hull Figure 12. The trigger could be either mechanical or electrical. It could be armed with an RFD (radio-controlled firing device) or the like. When the trigger is activated, the explosive train is initiated by an electric or a non-electric cap.

In another embodiment, another type of explosive solution could be used. The barrier would have a vertical wall that floats above the water. Below the water a hinged arm would extend some distance out, and on the end of the arm would be a shaped explosive charge. Many of these hinges with explosives would be along the wall, underwater. When the wall is pushed backwards by a vessel trying to force its way through, the hinge swings up underneath the vessel and the shaped charge hits the bottom of the hull. On contact with the hull the charge would be initiated, either electrically or non-electrically, causing the shaped charge to explode.

Because the charge is surrounded by water except where the face of the shaped charge is against the hull, the force of the explosion would be imparted exclusively into the attacking vessel. A stand off buffer could be used, filled with air that would allow the slug some time to accelerate before driving into the vessel. A shaped charge may not be needed; any explosive may suffice depending upon requirements.

In another embodiment, the present invention may also include a system that stops an incoming vessel by snaring the propellers. The barrier would float on the surface and would be made of rope, nylon cord, polypropylene line or thin metal filament line that would become wrapped in the propeller of the attacking vessel as it attempts to break through. The barrier could have use a series of fishing nets, or something similar, tightly packed together. The barrier would also have flexible material at and below the surface to fowl the intakes of the engine. Suitably shaped object can also be places under the surface that would be sucked into the intakes of a hydro-jet type types propulsion device (as opposed to a propeller driven vessel.)

CLAIMS

1. Apparatus for protecting ships or harbors from attack by vessels comprising:

a capture device formed by a net of strong material to be disposed above a water surface,

masts attached to the net for maintaining the net in an upright orientation,

a plurality of buoys floatable on a water surface to which the masts are attached for supporting the respective masts,

ballast weights adapted to be secured to lower ends of the respective masts, and

anchors connected to sections of the net for providing a restraining force on the net against predetermined movement of the net.

2. An apparatus as in Claim 1 wherein the anchors to impart a downward force to the bow of an attacking vessel.

3. An apparatus as in Claim 1 wherein the anchors to impart a lateral force to the bow of an attacking vessel.

4. An apparatus as in Claim 1 wherein the anchors impart a downward and lateral force to the bow of an attacking vessel.

5. An apparatus as in Claim 1 wherein the anchors comprise sea anchors.

6. An apparatus as in Claim 1 including brakes connected to the net.

7. Apparatus for protecting ships or harbors from attack by vessels comprising a capture device formed by a net of strong material to be disposed above a water surface

masts attached to the net for maintaining the net in an upright orientation,

a plurality of buoys floatable on a water surface to which the masts are attached for supporting the respective masts,

ballast weights adapted to be secured to lower ends of the respective masts, and

anchors connected to sections of the net for providing a restraining force on the net against predetermined movement of the net whereby a bow of a vessel engaging the net causes the anchors to be pulled which in turn provides resistance to impart a downward force to the bow of an attacking vessel.

8. Apparatus for protecting ships or harbors from attack by vessels comprising a deployable "wall of water" comprising

a plurality of water compartments forming a vertical structure comprising a sea wall for containing water to form a vertical wall of water,

flotation chambers attached to the structure for retaining the structure in a vertical orientation, and

the compartments of the structure and chambers are formed of resilient material allowing the same to be rolled or folded into a storage container for storing the sea wall when not in use and the container being attachable to the side of a ship or harbor to be protected.

9. Apparatus as in Claim 8 wherein the sea wall is an elongated vertical structure which can be disposed alongside a ship or harbor to be protected from attack.

10. A method for protecting ships or harbors from attack by vessels via a deployable "wall of water" comprising forming a vertical wall of water alongside a ship or harbor by providing water-filled resilient chambers secured together to form a vertical structure comprising a sea wall, and

floating the sea wall adjacent a ship or harbor to be protected.

11. A method as in Claim 14 wherein the sea wall is provided to stop a vessel.

12. A method as in Claim 14 wherein he sea wall is used for blast mitigation.

13. Apparatus for protecting ships or harbors from attack by vessels, substantially as hereinbefore described, with reference to the accompanying drawings.

14. A method of protecting ships or harbors from attack by vessels, substantially as hereinbefore described.

14

INVESTOR IN PEOPLE

Application No: GB 0212033.5
Claims searched: 1 to 7

Examiner: Richard Collins
Date of search: 19 July 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): B7A AAAT, AAHB.

Int Cl (Ed.7): B63G 9/00, 9/02, 9/04, 13/00; F41H 11/00, 11/05.

Other: Online EPODOC, JAPIO, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	US 4961393 A	(MURRAY) see figures 1 and 3 especially	-
A	US 4625668 A	(FITCH) see figures 6 and 8 especially.	-
A	US 2369464 A	(JOSEPH) see figures 1 to 4.	-
A	JP 2001091194 A	(ONODERA) see figures and abstract.	-

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